



Resident Research Associateships  
Postdoctoral and Senior Research Awards

tenable at the  
Federal Aviation Administration

# ***Civil Aerospace Medical Institute***

Oklahoma City, Oklahoma

Administered by the National Research Council  
Washington, DC

2003

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Postdoctoral and  
Senior Research Awards

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OPPORTUNITIES FOR RESEARCH

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Federal Aviation Administration  
CIVIL AEROSPACE MEDICAL INSTITUTE  
Oklahoma City, Oklahoma

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NATIONAL RESEARCH COUNCIL  
Washington, DC

# THE NATIONAL ACADEMIES

National Academy of Sciences  
National Academy of Engineering  
Institute of Medicine  
National Research Council

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. William A. Wulf is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. William A. Wulf are chairman and vice chairman, respectively, of the National Research Council.

One of the National Research Council's six major divisions, the Policy and Global Affairs Division, is charged with administering Research Associateships and Summer Faculty awards through its Associateship Programs office.

## *Foreword*

The Civil Aerospace Medical Institute (CAMI) is the medical certification, research, and education wing of the United States Department of Transportation Federal Aviation Administration's (FAA) Office of Aerospace Medicine at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma. The overall mission of the Institute is to ensure civil aerospace safety through excellence in aerospace medical certification, education, and aerospace medical/human factors research. Two research divisions within CAMI sponsor National Research Council Research Associates.

The Aerospace Human Factors Research Division conducts an integrated program of field and laboratory performance research in organizational and human factors aspects of aviation work environments. Research includes, but is not limited to, human performance under various conditions of impairment, human error analysis and remediation, agency work force organization, training analysis and career enhancement, impact of advanced automation systems on personnel requirements and performance, human factors evaluations of performance changes associated with advanced multifunction displays and controls in general aviation and air traffic control, and the psycho-physiological aspects of workload and work scheduling on job proficiency and safety in aviation related human-machine systems. The Division is comprised of two research laboratories: the Aerospace Human Factors Research Laboratory and the Training and Organizational Research Laboratory.

The Aerospace Medical Research Division is responsible for enhancing human safety, security, and survivability in civilian aerospace operations. The program provides the primary bioaeronautical research associated with civilian aerospace safety and performance. There are three main research activities: (1) investigation of the injury and death patterns in civilian flight accidents along with meticulous analysis to determine cause(s) and prevention strategies; (2) development of recommendation for protective equipment and procedures; and (3) evaluation of options, on behalf of FAA regulatory and medical certification staff charged with the proposal of safety and health regulations addressing all aircraft cabin occupants. This research program identifies human tolerances, capabilities and failure modes (physiological, psychological, and

performance) both in uneventful flights, and during civilian inflight incidents and accidents. The research results enable the FAA to exploit new and evaluate existing bioaeronautical guidelines, standards, and models for air and spacecraft cabin equipment, procedures, and environments. The Division is comprised of two research laboratories, the Bioaeronautical Sciences Research Laboratory and the Aeromedical Protection and Survival Laboratory.



## *Introduction*

### History and Objectives

The National Research Council conducts the Research Associateship Programs in cooperation with sponsoring federal laboratories and research organizations approved for participation.

The National Research Council, through its Associateship Programs office, conducts a national competition to recommend and make awards to outstanding scientists and engineers at recent postdoctoral and experienced senior levels for tenure as guest researchers at participating laboratories. These Programs have been conducted on behalf of a number of federal agencies since 1954.

The objectives of the Programs are (1) to provide postdoctoral scientists and engineers of unusual promise and ability opportunities for research on problems, largely of their own choice that are compatible with the interests of the sponsoring laboratories and (2) to contribute thereby to the overall efforts of the federal laboratories.

For recent doctoral graduates, the Programs provide an opportunity for concentrated research in association with selected members of the permanent professional laboratory staff, often as a climax to formal career preparation.

For established scientists and engineers, the Programs afford an opportunity for research without the interruptions and distracting assignments of permanent career positions.

Participating laboratories receive a stimulus to their programs by the presence of bright, highly motivated, recent doctoral graduates and by senior investigators with established records of research productivity. New ideas, techniques, and approaches to problems contribute to the overall research climate of the laboratories. Indirectly, Associateships also make available to the broader scientific and engineering communities the excellent and often unique research facilities that exist in federal laboratories.

For the 2003 program year, an anticipated 750 applications will be received for the nearly 300 new awards to be made in the Associateship Programs.

## Associates on Tenure

A Research Associate is a guest researcher, not an employee of the National Research Council or of the laboratory. Associateships are analogous to fellowships or similar temporary programs at the postdoctoral level in universities and other organizations. They are not intended to be, or to compete with, permanent professional career positions.

No commitment on the part of an Associate, the sponsoring laboratory, or the National Research Council with regard to later employment is implied or should be inferred by the offer or acceptance of an award.

Associates must devote their full-time effort to the research program proposed in their applications and must be in residence at the sponsoring laboratory during the entire period of the Associateship. No period of tenure may be spent in residence at another laboratory or institution. Associates have the status of visiting scientists or engineers but are subject to the general regulations of the laboratory.

No additional monetary aid or other remuneration may be accepted from another appointment, fellowship, or similar grant, except for sabbatical leave, during the period of the Associateship.

## Postdoctoral or Senior Research Associate Status and Length of Tenure

Postdoctoral Research Associateships are awarded to persons who have held the doctorate less than five years at the time of application and will be made initially for one year.

Senior Research Associateships are awarded only to applicants who have held the doctorate five years or more at the time of application or to persons who hold a permanent appointment in academia, government, or industry and have research experience that has resulted in significant contributions and recognition as established investigators in their specialized fields. Although awards to Senior Research Associates are usually for one year, awards for periods of three months or longer may be considered.

Under certain conditions, extensions may be granted to allow Associates to bring their research to a reasonable stage of completion. However, extensions are not automatically granted, and applicants are advised to plan their research programs to conform to the length of tenure stated above.

## Consideration

Qualified applicants will receive consideration without regard to race, creed, color, age, sex, or national origin.

## Citizenship

Opportunities at the Civil Aerospace Medical Institute (CAMI) are open to all citizens of the United States and to citizens of other countries who have full command of the English language.

## Permanent Resident Status

If an applicant does not yet have permanent resident status and intends to apply to obtain it, the National Research Council cannot act as a sponsor employer of the applicant to the Immigration and Naturalization Service.

## Visa Requirements

Non-US nationals who are offered awards must have valid visas throughout tenure. Only exchange visitor and immigrant visas are acceptable to the National Research Council. If an awardee chooses to apply for an exchange visitor visa, sponsorship must be by the National Research Council. If he or she chooses to apply for an immigrant visa, the National Research Council will not be involved in the procedure.

## Education and Experience

Awardees must hold the PhD, ScD, or other earned research doctoral degree recognized in US academic circles as equivalent to the PhD or must present acceptable evidence of having completed all the formal academic requirements for one of these degrees before tenure may begin. Applicants must have demonstrated superior ability for creative research.

An applicant's training and research experience may be in any appropriate discipline or combination of disciplines required for the proposed research.



## Research at CAMI

This booklet contains abstracts, or opportunities for research that describe areas of research in which Associateships may be awarded at CAMI.

CAMI provides the funds for this program and furnishes all necessary support services, facilities, and equipment for the approved research program of each Associate.

While every effort has been made by CAMI to provide opportunities of ample scope and relevance, the publication of any opportunity in this booklet does not guarantee that it will be available at the time awards are offered. Changes and/or deletions may occur following publication because of temporary lack of equipment, laboratory renovation, staffing already sufficient to meet research goals, or a lack of funding.

## Research Adviser and Laboratory Program Representative

Shown with each opportunity for research are the names of one or more Research Advisers who conduct or direct the work described in the opportunity.

An Adviser is a scientist or engineer at CAMI with whom a Postdoctoral Research Associate works most closely. An Adviser acts as a surrogate of the National Research Council in monitoring an Associate, and all matters relating to an Associate's research program fall under his or her purview.

For a Senior Research Associate, an Adviser functions in a more collegial relationship and assists as needed in securing technical support and resources.

The Laboratory Program Representative is a professional staff member who is responsible for managing CAMI's Research Associateship program and for assisting an Associate with all administrative aspects of tenure:

Melchor J. Antunano, M.D., M.S.  
Director, FAA Civil Aerospace Medical Institute  
MMAC, CAMI, AAM-3  
PO Box 25082  
Oklahoma City, Oklahoma 73125  
Telephone: (405) 954-1000 or 1001  
FAX (405) 954-1010  
E-Mail: [melchor.j.antunano@faa.gov](mailto:melchor.j.antunano@faa.gov)

## Research Proposal

Each applicant must submit a research proposal that relates to a specific opportunity for research at CAMI. A proposal must be the original work of an applicant and be approved by an Adviser listed with the opportunity.

Before writing a proposal, however, an applicant is advised to communicate directly with the Adviser, who can provide more specific information on current research and available technical facilities and offer scientific support of proposal development.

## Laboratory/Center Review

Each applicant's proposal must be approved by one of the Advisers listed in this booklet and endorsed by the Program Committee of CAMI to be eligible for an award.

The endorsement affirms that the proposal is compatible with CAMI's interests and that adequate programmatic support will be available if an award is offered.

CAMI's action on the proposal, together with a copy of the Adviser's comments, will be provided directly to the applicant by the Laboratory Program Representative.

No applicant will be eligible for further consideration until the Associateship Programs office has been advised by CAMI that his or her proposal has been approved by an Adviser and endorsed by the Program Committee. Otherwise, the Associateship Programs office will assume that the proposal is not of sufficient current interest to CAMI or that support facilities cannot be made available.

Since the final review of applications is conducted by special panels appointed by the National Research Council, all applicants should note that endorsement by an Adviser or laboratory, while essential to the application process, does not imply or guarantee an award by the National Research Council.

## The Panel Review

The Associateship Programs office receives all application materials and supporting documents and conducts the competitive evaluation of applications.

Evaluations for CAMI Associateships are conducted by special panels convened for this purpose. Panelists are chosen to review applications on the basis of their stature and experience in the fields of science and engineering, and their evaluations become the basis from which awards are made on behalf of CAMI.

Applicants are recommended for awards only after this open, national competition, in which the panels rank candidates on the basis of quality alone.

Final ranking in order of quality and the recommendation of applicants for awards are the exclusive prerogatives of the panels, and only notification by the Associateship Programs office of an applicant's status in the competition is authoritative.

## Stipend

An Associate receives a stipend from the National Research Council while carrying out his or her proposed research. At CAMI, the current annual stipend for a Postdoctoral Research Associate is \$42,000. An appropriately higher stipend will be offered to Senior Research Associates.

This stipend is subject to adjustments from time to time in accordance with general national guidelines pertaining to scientists and engineers.

The National Research Council is required by the US Tax Code to withhold an amount from the stipends of non-resident aliens who hold exchange visitor (J-1) visas. Exchange visitors are advised that approximately 30% per month will be withheld from stipends and reported to the US Internal Revenue Service annually.

Applicants are cautioned against entering into any agreement or understanding with individual Advisers or other laboratory personnel for additional funding or other remuneration for work as an Associate.

Stipends for Associates are limited to the amounts and by the conditions set forth above, and any other arrangement, formal or informal, between an applicant and laboratory personnel for additional monies or other considerations is strictly prohibited by the National Research Council.

## Initiation of Tenure

Sufficient time must be allowed between the offer of an award and the beginning of tenure to enable the Associateship Programs office and CAMI to complete all necessary administrative procedures.

The date on which tenure may begin is negotiated on an individual basis, normally within six months of the award. The starting date may be delayed by mutual agreement of CAMI, the Associate, and the Associateship Programs office but cannot be later than 12 months from the date on which the award was originally offered.

If this condition cannot be met, a new application, including a newly approved research proposal, must be submitted to the Associateship Programs office and will be judged without prejudice in the next competition.

## Prior Affiliation with the Laboratory

A primary objective of the Associateship Programs is to provide a mechanism for new ideas and sources of stimulation to be brought to the sponsoring laboratory. Thus, persons with recent prior affiliation with a specific laboratory may not be eligible to apply for an Associateship there.

Prior affiliation includes direct employment relationships either with the laboratory or with a contractor whose work is performed there. A long-term consulting relationship usually makes an applicant ineligible.

Research contracts with universities that provide support for graduate students or faculty who perform research on campus are not ordinarily considered to be disqualifying.

## Reapplication

Persons who have previously held an Associateship may apply for another award only if a period of at least two years will have elapsed between termination of the first award and the proposed tenure of a second.

Persons who have previously applied for an Associateship, but who were not recommended for an award by the panels, may reapply after one year.

Candidates who were recommended for an award by the panels, but who were not offered an award because of funding or other limitations, may reapply at any time without a mandatory waiting period.

## Taxes and Insurance

As a guest investigator, an Associate is self-employed. All arrangements for payment of income taxes are the responsibility of the individual Associate, who is advised to become familiar with the relevant sections of the current tax codes.

The National Research Council is required by the US Tax Code to withhold an amount from the stipends of non-resident aliens who hold exchange visitor (J-1) visas. Exchange visitors are advised that approximately 30% per month will be withheld from stipends and reported to the US Internal Revenue Service annually.

Job-related injury or death is covered by insurance (workmen's-compensation type). A group health-insurance program is required for Associates and is optional for dependents.

## Relocation and Travel

A suitable relocation reimbursement is determined for each awardee. Funds are also available for limited professional travel during tenure, provided such travel is approved in advance by the Associate's Adviser, the CAMI Program Representative, and the Associateship Programs office. Details will be provided at the time of the award.

## Publication

Since an Associate's later scientific and technical career will be judged by others, publication in the accepted open technical literature is highly encouraged.

Publications should include a statement indicating that the research was conducted while the author held a National Research Council Research Associateship.

## Application Procedure

This application procedure is a "self-managed" process. Application forms are available on our Web site at [national-academies.org/rap](http://national-academies.org/rap). The applicant is responsible for preparing, collecting, and submitting all documents by the published deadlines. A Checklist is included with the application forms. Complete, sign, and date this Checklist and place it as a cover sheet for the



documents included in the National Research Council package. Incomplete packages will be discarded, and documents sent under separate cover will not be accepted.

Application deadlines are February 1, May 1, August 1, and November 1. All deadlines for receipt of application materials are strictly observed by the laboratory and the Associateship Programs office. No allowances or exceptions are made for late submissions.

Application materials from previous competitions may not be used.

If you need to contact us:

Mail

Associateship Programs  
GR 322A  
National Research Council  
500 Fifth Street, NW  
Washington, DC 20001

Fed-Ex Only

2001 Wisconsin Avenue, NW  
GR 322A  
Washington, DC 20007

E-Mail: [rap@nas.edu](mailto:rap@nas.edu)

Internet: [national-academies.org/rap](http://national-academies.org/rap)

Please consult our Web site ([national-academies.org/rap](http://national-academies.org/rap)), which is updated regularly throughout the year, for application deadlines and the most current information on available Research Opportunities.

## Laboratory/Center Documents

The Adviser will review the proposal and forward it to the Program Committee for review.

## Notification of Awards

Awards are made only by the National Research Council. The endorsement of an application and research proposal by CAMI, while essential to the application and review processes, does not constitute an agreement or obligation to confer an award.

A review board, drawn from members of the National Research Council panels, determines a cutoff score. Applicants who score below this score cannot be considered further for an award and are so notified within two to four weeks.

Applicants who score above the cutoff score are recommended for awards by the board. These applicants are notified of the board's action as early as possible and are offered awards or alternate status to the extent of available facilities and funding by CAMI.

Acceptances and declinations must be made directly to the Associateship Programs office of the National Research Council.

## *Opportunities for Research*

### AEROSPACE HUMAN FACTORS RESEARCH DIVISION

#### **Human Error Associated with Aviation Accidents**

SA Shappell

31.10.00.B5224

Humans, by their very nature, make mistakes. Thus, it should come as no surprise that human error has been implicated in 70 to 80% of civil and military aviation accidents. The predominant means of investigating the causal role of human error in aviation accidents remains the analysis of accident and incident data. Unfortunately, most accident reporting systems are not designed around any theoretical framework of human error. However, recently a comprehensive Human Factors Analysis and Classification System (HFACS) was developed to investigate aviation accidents and analyze human errors associated with post-accident data. HFACS has proven quite useful within the US Military (primarily the US Navy/Marine Corps where it was developed) and has recently been applied to commercial and general aviation accidents by scientists at CAMI. To date, HFACS has been used to examine human error associated with over 20,000 civilian and military aviation accidents within the US. CAMI scientists are particularly interested in the specific types of human error associated with general aviation accidents. For instance, when HFACS was applied to the general aviation accidents occurring between 1990-98, it revealed that nearly 80% of the accidents were attributable, at least partially, to skill-based errors. To a lesser extent, decision errors, violations, and perceptual errors have also been implicated. Future efforts will focus on a thorough understanding of the specific types of errors associated with these major categories and the physical, mental, and social preconditions that promote them so that specific accident interventions and mitigation strategies can be identified.

### **Advanced Flight-Deck Systems and Flight-Crew Performance**

DB Beringer

31.10.00.B5225

This applied research centers on the examination of pilot performance in flight simulations using advanced displays and controls (emphasis on general aviation). CAMI's two re-configurable general aviation research simulators are available to investigate the effects of displays and controls, pilot experience, workload, and weather conditions on pilot decision-making and performance. Measurement of flight technical performance, eye-movements, cognitive performance, and the usability of advanced displays and controls are emphasized. Field research focuses on assessing pilot reactions to and performance associated with the introduction of advanced displays. The research program provides an opportunity to impact rule-making activities and to contribute to the creation of design and performance standards. Opportunities are available to examine aircraft accident causation through use of simulation and to define interventions for increasing flight safety. In addition, research investigations in simulators and in field settings are used to identify the effects of pilot conditions such as fatigue, stress, and work schedules on performance on the flight deck and in air traffic control settings, with particular attention to the efficacy of fatigue countermeasures. Consideration will also be given to proposals designed to assess human factors associated with manned commercial space operations.

### **Measuring Cognitive Complexity and Performance in Air Traffic Control**

CA Manning

31.10.00.B5226

Automation that aids air traffic controllers' performance and efficiency is currently being developed. These different pieces of software, which are being developed by different organizations, will be displayed in different windows on the radar controller's main 20" x 20" situation display. There is some concern that having multiple windows containing different data sources on the situation display may increase the en route controllers' workload rather than decrease it. The Aerospace Human Factors Research Division has developed a set of measures to assess taskload and performance in air traffic control. This set of baseline measures will be used to evaluate the effects of the introduction of new technologies and procedures on controller taskload and performance. Additional measures are needed to evaluate the "cognitive complexity" of the components of an air traffic control display. The measures should allow computation of a numeric rating on one or more dimensions, such as physical space, data entry/retrieval requirements, and effort involved in interpreting information. This

project is part of a broader effort to develop and test measures of taskload, performance, and sector complexity using routinely recorded air traffic control data and/or developing prototype methods for displaying air traffic data. Available resources include access to relevant technical reports; recorded air traffic data; equipment to re-create air traffic data samples; and en route simulation facilities, equipment, and software.

### **Personnel Selection for Safety-Sensitive Jobs**

ER Fiedler

31.10.00.B5227

Job performance results from the interaction of individual differences with job requirements within a specific organizational context. This research focuses on modeling the relationship between individual differences, job requirements, and organizational influences as expressed in human performance in safety-sensitive, aviation occupations such as air traffic control specialist, airway transportation systems specialist, pilot, civil aviation security screener, and Federal air marshal. Research on individual differences includes work on the identification, definition, and measurement of cognitive abilities; personality; knowledge and skill; and biographical data for safety-critical occupations. The work requires the application of advanced psychometric methodologies and theory-based models of individual differences to the development of practical and innovative computer-administered assessment tools. Research on job requirements encompasses work on job analysis methodologies, identification of current (baseline) task/job characteristics, analysis of future systems characteristics and requirements, and development of task/job characteristic taxonomy for use in the analysis of future air traffic management system requirements. Other work focuses on occupational workforce planning, including modeling of retirements and attrition from key occupations. Research on performance assessment includes identification of relevant performance dimensions and development of performance assessment methods. Finally, the organizational context within which job performance is expressed is only recently being recognized as a significant influence on job performance. Research on organizational influences seeks to identify and measure how organizational factors such as job design, reward systems, management structures, performance expectations, and organizational culture influence job performance. These lines of research are brought together in large-scale, field-based validation studies to test hypotheses about the relationship between person and job characteristics in complex jobs characterized by a high degree of responsibility for public safety. Other research



tools include low- and high-fidelity simulations of air traffic control and pilot tasks and large ( $n > 10,000$ ) longitudinal data bases for several safety-sensitive occupations.

## AEROSPACE MEDICAL RESEARCH DIVISION

### **Mathematical Modeling for Aerospace Protection and Survival**

RM Shaffstall

31.20.00.B5228

To support FAA safety objectives, specific research efforts toward the identification, refinement, or development of mathematical models in aircraft or spacecraft accident biodynamics, emergency evacuation, environmental and altitude physiology, and cabin airflow dynamics are required. Significant documentation and data bases are available in the FAA and aviation industry to support modeling efforts and model application. Both the FAA and the worldwide aviation safety community have initiated development of models that are applicable to these areas; however, further efforts are required. In areas where models have been developed; further work in identification, selection, and validation is needed. Similarly, the development/application of physiological and environmental models could facilitate rule making and support improved safety in civilian space travel. Relative to the aerospace environment, space exploration/research efforts have involved small numbers of young, highly trained, physiologically fit individuals. Space exposure of a different population may require development of data bases and criteria for medical certification and the use of medications. Additionally, space related efforts would require development of guidelines for personal protective equipment, survival/crashworthiness standards, and a better understanding of the effect of microgravity. Modeling, data base development, and space research efforts will assist in FAA certification and rule-making activities, and will provide direction for future research.

### **Radiobiology: Radiation Safety in Aerospace Environments**

W Friedberg

31.20.00.B5229

Crewmembers on commercial aircraft are exposed to higher doses of ionizing radiation than normally received by members of the general population in most parts of the world. In the current aviation environment, the principal radiation source is galactic cosmic radiation. On rare occasions, radiation from the Sun can lead to a substantial increase in the ionizing radiation at aircraft flight altitudes. In the space environment, the potential for radiation exposure is significantly increased and may become a limiting factor for specific space missions. Aircrew in both the aviation and space environment are also exposed

to nonionizing radiation in the form of electric and magnetic fields generated by the aircraft's electronic and electrical systems. General research requirements include further definition of radiation exposure of aircraft crews and definition of associated health risks; effects of neutrons, microwaves, and x rays on mammalian embryos; and radiation shielding options for space vehicles. Computer software (CARI program) for estimating the amount of galactic cosmic radiation received on aircraft flights has been developed. The software, which can be accessed from the Internet, is frequently updated to improve its reliability and to take into account special needs of users. Research is ongoing to improve methods for calculating radiation flight doses during a solar proton event and to develop a Solar Radiation Alert system that will warn airlines of the start of a potentially hazardous solar proton event; further development to facilitate application is needed.

### **Aerospace Vision Research**

VB Nakagawara

31.20.00.B5230

Safety in the National Airspace System depends on reducing the risk of individuals experiencing sudden or subtle incapacitation or having a condition that may compromise performance to an extent that it may cause or contribute to an aerospace accident or incident. A significant body of research is available in the general area of vision and aviation. However, much of this research is derived from or applies to military aviators who have traditionally been required to meet stringent vision requirements. For the civilian airman, research is needed for current and anticipated vision problems in both civil aviation and space-related activities where vision standards are necessarily different from the military. In addition, research is necessary to assess whether existing standards are compatible with newly developed aerospace technologies and procedures used by civilian airmen and personnel responsible for supporting aerospace activities. Data base research can provide a means of analyzing the past performance of civilian airmen who fly with various visual pathologies and corrective modalities in order to guide future regulatory policy decisions. General areas of research interest include the evaluations of international vision standards relative to visual performance in the aviation environment, visual performance assessments of current and advanced vision corrective devices and refractive surgical procedures in the aviation and space environments, evaluations of the effects of aging and chronic disease as they relate to pilot

visual performance, and evaluations of emergent techniques in vision screening procedures and their applicability to aviation.

### **Biochemical Research**

AK Chaturvedi

31.20.00.B5231

Biochemical research focuses on the areas of forensic toxicology quality control and quality assurance, combustion toxicology, molecular biochemistry, and drug testing adulteration/dilution/substitution. In addition to the development of new analytical toxicology procedures for primary combustion gases and pharmacological agents in biological samples, new efforts involve establishing changes in gene-expression patterns as a result of challenges to environmental stimuli relevant to aviation and space transportation, and correlating those changes with biochemical, physiological, performance, and/or toxicological responses. The environmental stimuli could be combustion gases, hypoxia, drugs, radiation, physical stress, environmental factors, and gravitational forces. Initial experiments will be conducted in animal models and changes in gene-expression patterns in various cell types, including leukocytes, will be evaluated with the resulting responses being measured. Findings will subsequently be tested in human subjects wherein gene-expression pattern changes in leukocytes will be correlated with the responses. These experiments entail micro-array techniques, including syntheses of cDNA and proteins, and other techniques to measure applicable responses. Various bioanalytical techniques will be developed, and drugs and their metabolites will be quantitated in biological samples, such as blood, to correlate the analyte concentrations with the observed responses. Findings from these studies will be helpful in elucidating the mechanism of action of those stimuli. Detection of an altered gene expression and linking the patterns to physiological functions should serve as an early warning for adverse outcomes. Knowing these gene-level changes and the mechanism of action of stimuli, applicable diagnostic and therapeutic strategies can be developed and implemented so that the necessary precautionary and corrective measures can be taken to enhance aerospace safety.

### **Toxicological Analysis and Interpretation of Results from Transportation Accidents**

DV Canfield

31.20.00.B5232

The Aerospace Medical Research Division is responsible for research into the toxicological analysis of drugs in biological specimens obtained from

transportation accidents and research regarding the effects of these drugs on human performance. One ongoing research project involves the determination of the origin of ethanol in biological specimens taken from fatal transportation accidents. Ethanol is identified in approximately 8% of all aviation accidents. However, only about 2% of the cases can be directly associated with the ingestion of ethanol. This makes it impossible to determine the impact of ethanol ingestion in 6% of all aviation accidents. The investigation and litigation of these cases is confounded by not knowing the source of the ethanol identified in the body. Recently, a biological marker of ethanol intake has begun to gain interest in the field of forensic toxicology. Upon alcohol ingestion, the metabolism of ethanol disrupts the typical catabolic pathways of biogenic amines, particularly serotonin (5-HT) [1-3]. While under normal catabolic conditions, 5-hydroxyindoleacetic acid (5-HIAA) is the predominant end-product of 5-HT; in the presence of ethanol metabolism the catabolic pathway changes to produce greater amounts of 5-hydroxytryptophol (5-HTOL). This preferential change in 5-HT catabolism is attributed to competitive inhibition of aldehyde dehydrogenase (i.e., the enzyme responsible for producing 5-HIAA), by a metabolic product of ethanol (acetaldehyde), and/or elevated levels of NADH resulting from the oxidation of both acetaldehyde and ethanol. Either pathway promotes the formation of the reduced metabolite 5-HTOL over that of 5-HIAA. CAMI proposes to use this 5-HTOL/5-HIAA ratio methodology as it applies to postmortem body fluids and tissues. Our ultimate goal is to develop a method that will allow forensic toxicologists to differentiate between ingested ethanol and postmortem produced ethanol. Other research projects are associated with the affect of substances on human performance in aerospace transportation and their metabolism in the human body.

#### *Reference*

Canfield DV, et al: Aviation, Space and Environmental Medicine 72: 120, 2001



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## *Adviser Phone List*

Telephone, Electronic Mail, and mail inquiries concerning technical details of specific research opportunities may be made of the Advisers listed below.

Beringer, DB,	(405) 954-6828 dennis_beringer@mmacmail.jccbi.gov
Canfield, DV,	(405) 954-6252 dennis_canfield@mmacmail.jccbi.gov
Chaturvedi, AK,	(405) 954-6250 arvind_chaturvedi@mmacmail.jccbi.gov
Fiedler, ER,	(405) 954-6838 edna_fiedler@mmacmail.jccbi.gov
Friedberg, W,	(405) 954-6276 wallace_friedberg@mmacmail.jccbi.gov
Manning, CA,	(405) 954-6849 carol.manning@faa.gov
Nakagawara, VB,	(405) 954-6235 van.nakagawara@faa.gov
Shaffstall, RM,	(405) 954-5555 robert.shaffstall@faa.gov
Shappell, SA,	(405) 954-4082 scott_shappell@mmacmail.jccbi.gov

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## *2003 Research Associateship Programs*

Air Force Research Laboratory  
 Air Force Summer Faculty Fellowship Program  
 Albany Research Center  
 Armed Forces Radiobiology Research Institute  
 Edgewood Chemical and Biological Center–US Army Soldier and Biological Chemical Command  
 Federal Aviation Administration/Civil Aerospace Medical Institute  
 Federal Highway Administration/Turner-Fairbank Highway Research Center  
 Food and Drug Administration/Center for Devices and Radiological Health  
 NASA Ames Research Center  
 NASA Astrobiology Institute  
 NASA Dryden Flight Research Center  
 NASA John H. Glenn Research Center at Lewis Field  
 NASA Goddard Space Flight Center  
 NASA Jet Propulsion Laboratory  
 NASA Lyndon B Johnson Space Center  
 NASA John F Kennedy Space Center  
 NASA Langley Research Center  
 NASA George C Marshall Space Flight Center  
 NASA John C Stennis Space Center  
 National Energy Technology Laboratory  
 National Institute for Occupational Safety and Health  
 National Institute of Standards and Technology  
 National Institutes of Health  
 National Oceanic and Atmospheric Administration  
 Naval Medical Research Center/Naval Health Research Center  
 Naval Postgraduate School  
 Naval Research Laboratory  
 Space and Naval Warfare Systems Center  
 US Army Aviation and Missile Command  
 US Army Communications-Electronics Command/Night Vision and Electronic Sensors Directorate  
 US Army Medical Research and Materiel Command  
 US Army Natick Soldier Center–US Army Soldier and Biological Chemical Command  
 US Army Research Laboratories  
 US Army Research Office  
 US Army TACOM/Armament Research, Development, and Engineering Center  
 US Environmental Protection Agency  
 US Environmental Protection Agency Summer Faculty Fellowship Program  
 US Geological Survey



# National Research Council 2003 Research Associateship Programs Alphabetical by Acronym

Please Note: Unless otherwise indicated, all application deadlines are as follows:  
February 1, May 1, August 1, and November 1.

Organization	Accepts the Following Applicants		
	<i>Postdoctoral</i>	<i>Senior</i>	<i>Foreign</i>
<b>AFRL</b> Air Force Research Laboratory	Yes	Yes	Postdoctoral: No (except in special cases) Senior: Yes
<b>AFRRI</b> Armed Forces Radiobiology Research Institute	Yes	Yes	Yes
<b>AF/SFFP*</b> Air Force Summer Faculty Fellowship Program *Application deadline November 1 only	Yes (early career)	Yes	Legal permanent residents
<b>ALRC</b> Albany Research Center	Yes	Yes (limited number)	In special cases, if additional support is available
<b>AMCOM</b> US Army Aviation and Missile Command	Yes	Yes	In special cases
<b>AMRMC</b> US Army Medical Research and Materiel Command	Yes	Yes	Yes
US Army Medical Research Institute of Chemical Defense	Yes	Yes	No
US Army Institute of Surgical Research	Yes	Yes	Legal permanent residents
<b>ARL</b> US Army Research Laboratory	Yes	Yes	No
<b>ARO</b> US Army Research Office	Yes	Yes	Yes
<b>CAMI</b> FAA/Civil Aerospace Medical Institute	Yes	Yes	Yes
<b>CDRH</b> Center for Devices and Radiological Health	Yes	Yes	Yes

Organization	Accepts the Following Applicants		
	<i>Postdoctoral</i>	<i>Senior</i>	<i>Foreign</i>
<b>CECOM/NVESD</b> US Army CECOM/Night Vision and Electronic Sensors Directorate	Yes	No	No
<b>ECBC</b> Edgewood Chemical and Biological Center	Yes	Yes	In selected areas
<b>EPA</b> US Environmental Protection Agency	Yes	Yes	Yes
<b>EPA/SFFP*</b> US Environmental Protection Agency Summer Faculty Fellowship Program *Application deadline November 1 only	Yes (early career)	Yes	Legal permanent residents
<b>FHWA</b> Federal Highway Administration	Yes	Yes	Yes
<b>NASA — National Aeronautics and Space Administration</b>			
<b>ARC — Ames Research Center</b>	Yes	Yes	In selected areas
<b>DFRC — Dryden Flight Research Center</b>	Yes	Yes	No
<b>GRC — John H. Glenn Research Center at Lewis Field</b>	Yes	Yes	In selected areas
<b>GSFC — Goddard Space Flight Center Goddard Institute for Space Studies Wallops Flight Facility</b>	Yes	Yes	In basic science areas
<b>JPL — Jet Propulsion Laboratory</b>	Yes	Yes	In basic science areas
<b>JSC — Lyndon B. Johnson Space Center</b>	Yes	Yes	In selected areas
<b>KSC — John F. Kennedy Space Center</b>	Yes	Yes	In basic science areas
<b>LaRC — Langley Research Center</b>	Yes	Yes	In selected areas
<b>MSFC — George C. Marshall Space Flight Center</b>	Yes	Yes	In selected areas
<b>NAI — NASA Astrobiology Institute*</b> *Application deadline February 1 only	Yes	No	In selected areas
<b>SSC — John C. Stennis Space Center</b>	Yes	Yes	In selected areas

Organization	Accepts the Following Applicants		
	<i>Postdoctoral</i>	<i>Senior</i>	<i>Foreign</i>
<b>NETL</b> National Energy Technology Laboratory	Yes	Yes	Legal permanent residents
<b>NIH</b> National Institutes of Health	Yes	Yes	Seniors only; otherwise, Legal permanent residents
<b>NIOSH</b> National Institute for Occupational Safety and Health	Yes	Yes (limited number)	Yes
<b>NIST*</b> National Institute of Standards and Technology *Application deadline February 1 only	Yes	No	No
<b>NMRC/NHRC</b> Naval Medical Research Center Navel Health Research Center	Yes	Yes	Yes
<b>NOAA</b> National Oceanic and Atmospheric Administration	Yes	Yes	Yes
<b>NPS</b> Naval Postgraduate School	Yes	Yes	In selected areas
<b>NRL</b> Naval Research Laboratory	Yes	No	Legal permanent residents
<b>NSC</b> US Army Natick Soldier Center	Yes	Yes	Yes
<b>SPAWARSYSCEN San Diego</b> Space and Naval Warfare Systems Center	Yes	Yes	No
<b>TACOM-ARDEC</b> US Army Tank-Automotive and Armaments Command Armament Research, Development, and Engineering Center	Yes	Yes	No
<b>USGS*</b> US Geological Survey *Application deadline February 1 only	Yes	Limited number	Limited number